IGARSS Satellite Calibration/Validation Panel
Total Ozone Validation:
Lessons Learned from a Success Story

- Accurate Physical Parameters and Models
- Well-maintained Long-term Standards
- Lots of Data (Locations, Seasons, Years)
- Lots of Matchups
- Extensive Exchange of Information
- Stable Internal Calibration
- Well-designed Algorithms
- Opportunities for Internal Checks

Physical Parameters

- Ozone Absorption Cross Section
  - Wavelength dependence (all UV)
  - Temperature dependence
- Solar Measurements
- Rayleigh Scattering
- Forward Models

Long-term Standards

- Instrument #83 (World Dobson Standard)
  - Propagation to secondary standards
  - Shared support
  - http://www.ozonelayer.noaa.gov/action/dobson.htm

- NIST Traceable Satellite Calibration
  - Lamps
  - Spheres
  - Diffusers

Comparison of World Standard Dobson with TOMS and SBUVs

Provided by R. McPeters, NASA GSFC.

L. Flynn, NOAA/NESDIS, Slide 4
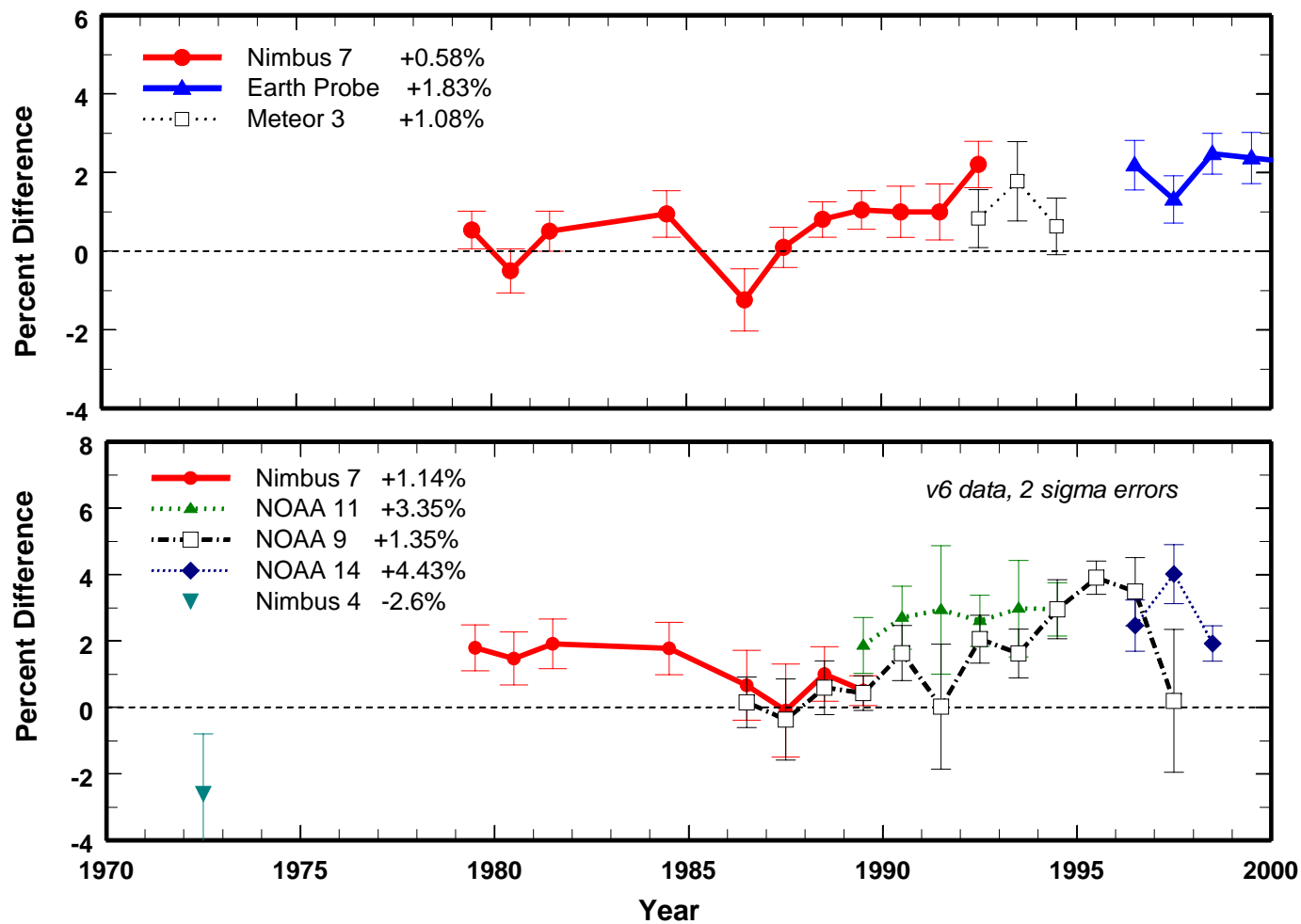
Lots of Available Data/Matchups

- **TOMS** has global daily coverage
- **SBUV/2** has 14 orbits/day
- **WOUDC** has data from 149 stations/ instruments
- 16 CMDL Stations
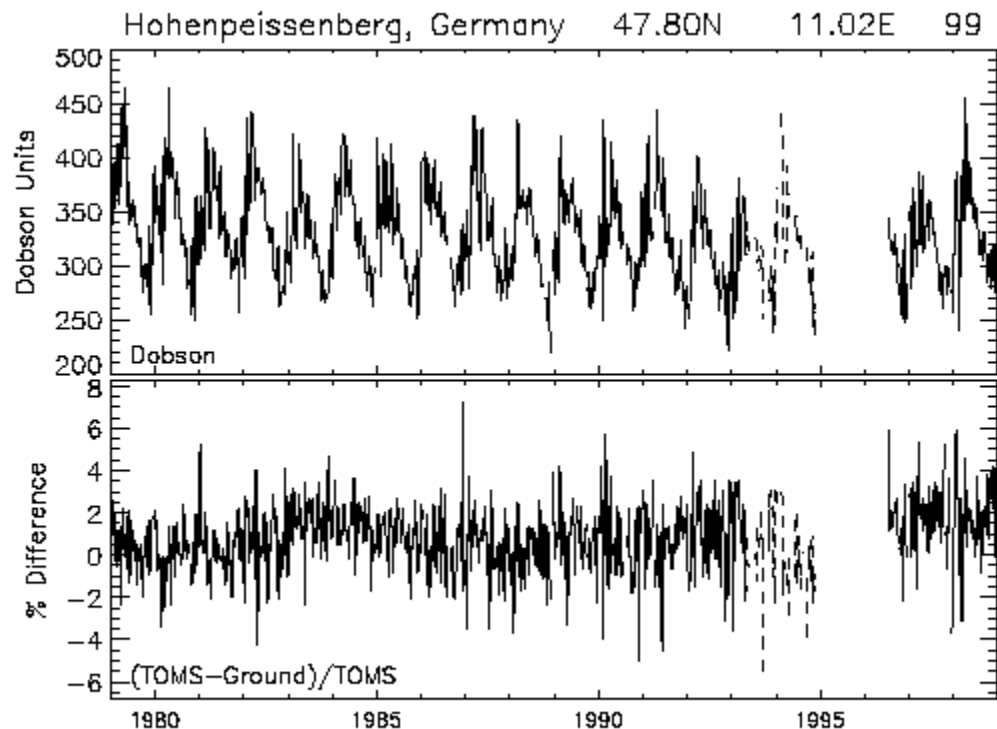
Plot from WOUDC web site.

WOUDC Data in Archive Summary Report: *149 records found.*

Report Date: 2002-06-25
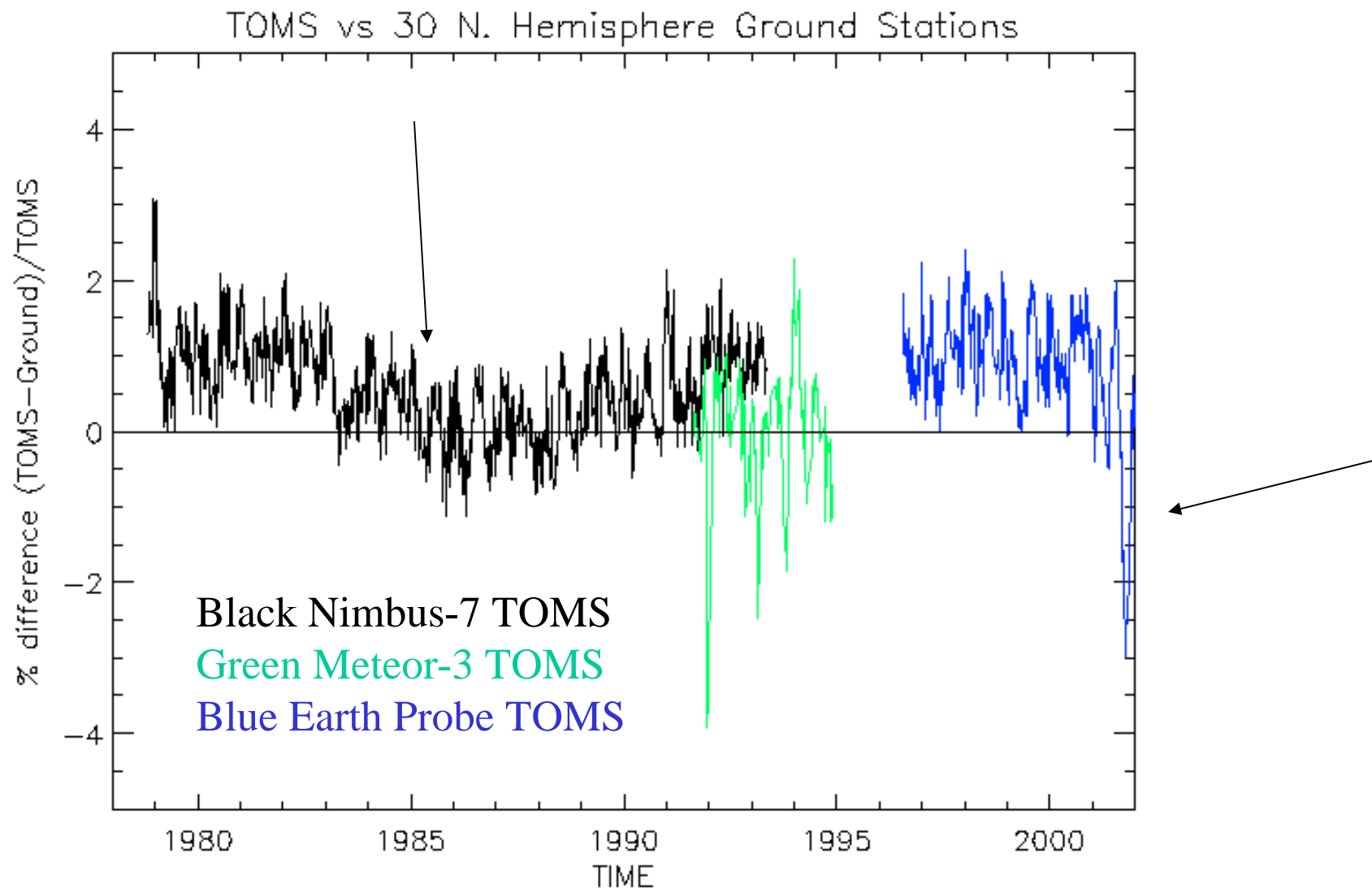**Category:** TotalOzone – Level 1.0
Instrument Type: Dobson

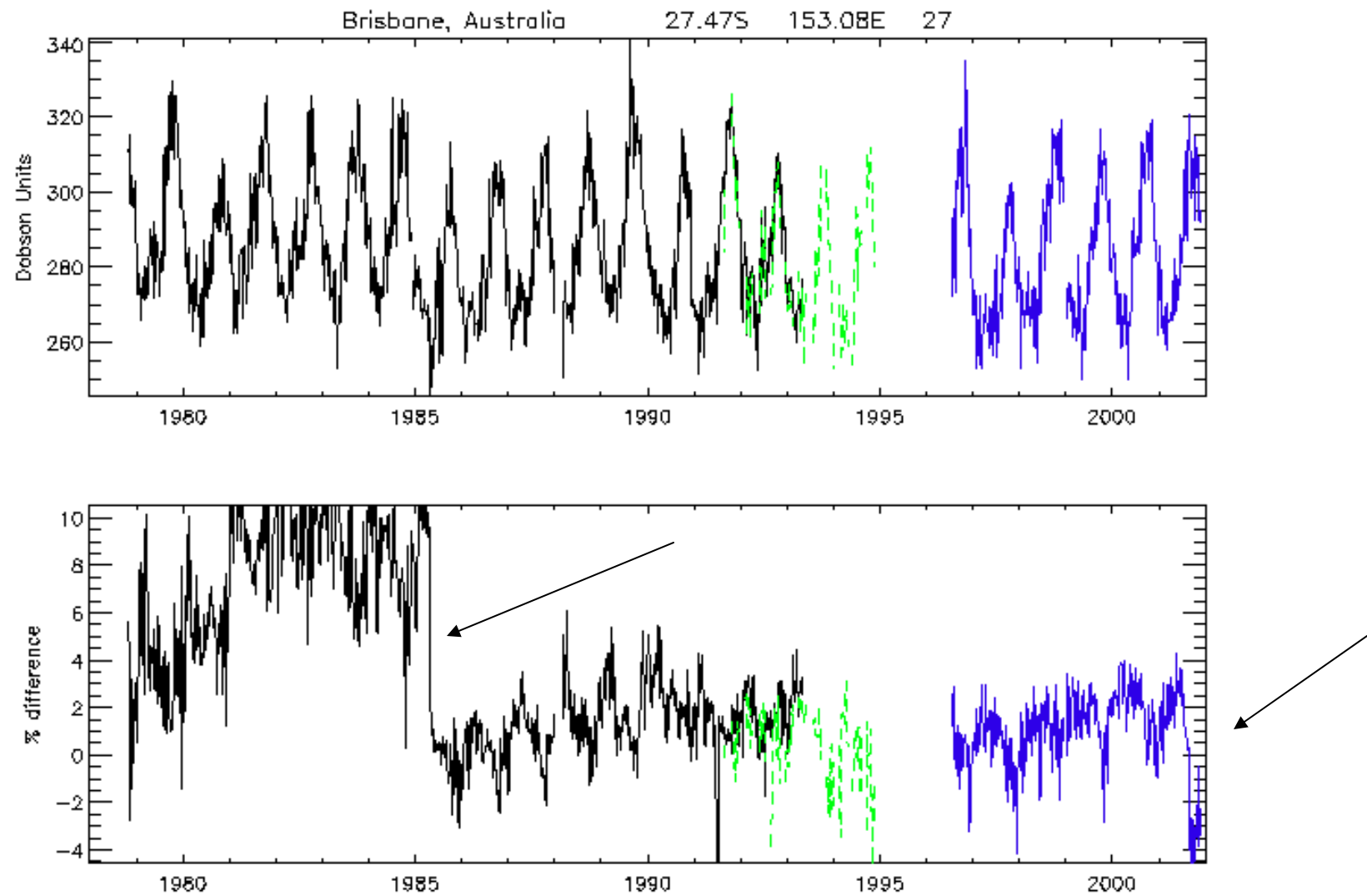| Platform ID	Instrument Type	Earliest Data	Latest Data	Last Updated	Files
STN 1	Dobson	1958-01-02	1959-06-27	2000-03-15	18
STN 2	Dobson	1957-09-26	2002-02-28	2002-04-08	109
STN 6	Dobson	1957-06-11	1958-02-28	2000-03-15	9
STN 7	Dobson	1958-02-27	2002-04-30	2002-06-10	495
STN 8	Dobson	1957-07-01	1998-04-25	2000-03-15	418
STN 9	Dobson	1951-10-21	1982-04-11	2000-03-15	248
STN 10	Dobson	1957-07-01	2002-04-30	2002-06-10	534
STN 11	Dobson	1957-07-01	2002-02-28	2002-03-25	469
STN 12	Dobson	1958-02-01	2002-04-29	2002-06-10	534
STN 13	Dobson	1957-07-01	1989-11-30	2000-03-15	343
STN 14	Dobson	1957-06-26	2002-04-30	2002-06-10	543
STN 15	Dobson	1957-11-02	1965-11-15	2000-03-15	51
STN 17	Dobson	1957-06-16	1967-12-31	2000-03-15	99
STN 18	Dobson	1957-07-04	1958-11-30	2000-03-15	17

Exchange of Information (Iteration)

- TOMS/Dobson Comparisons
  - Satellite as transfer
  - Record keeping
  - Long-term efforts
- Reprocessing and Improvements
- Continuing Campaigns and Special Studies
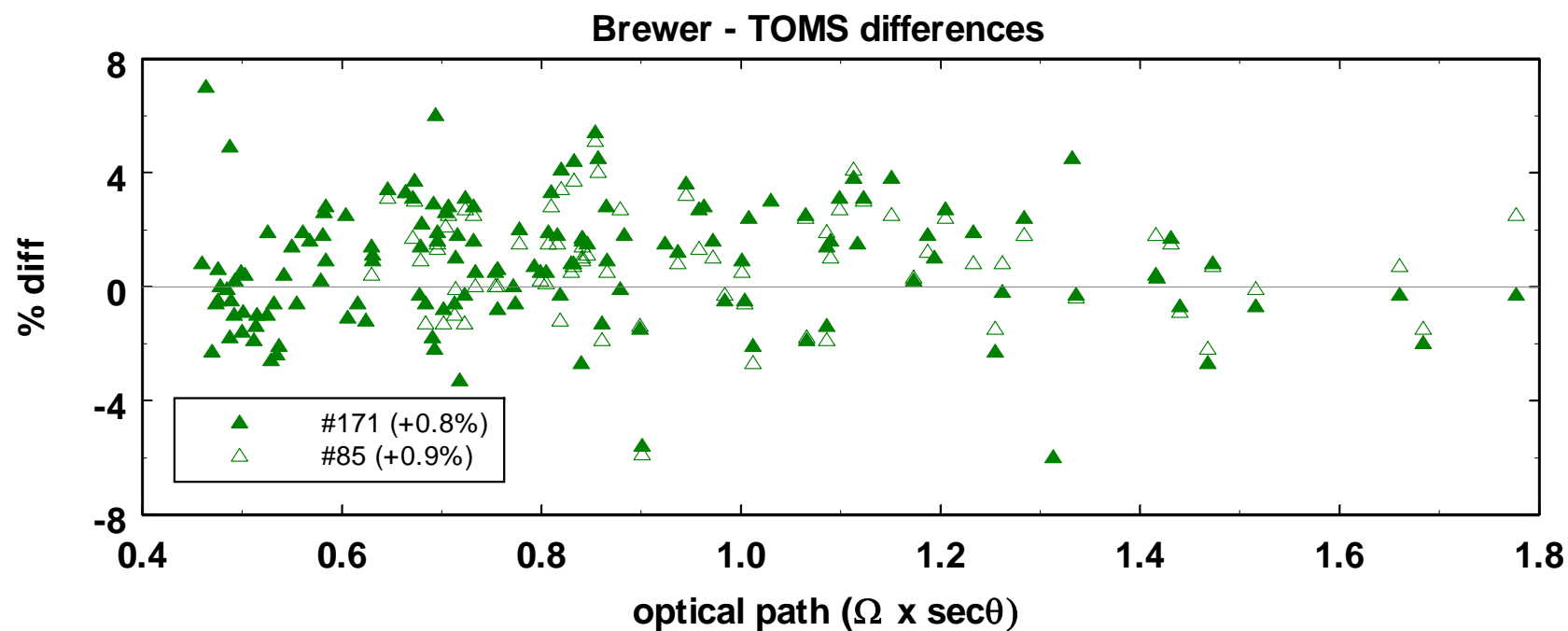 - Ozone intercomparison workshop (NZ)
  - TOMS3F (Fairbanks)

TOMS vs 30 N. Hemisphere Ground Stations

Black Nimbus-7 TOMS
Green Meteor-3 TOMS
Blue Earth Probe TOMS

Provided by G. Labow, NASA GSFC.

Provided by G. Labow, NASA GSFC.

Dobson - TOMS differences

(AD direct sun only)

I83 (-1.8%)
I63 (-2.9%)

Brewer - TOMS differences

#171 (+0.8%)
#85 (+0.9%)

optical path (Ω x secθ)

Provided by R. McPeters, NASA GSFC.

L. Flynn, NOAA/NESDIS, Slide 10
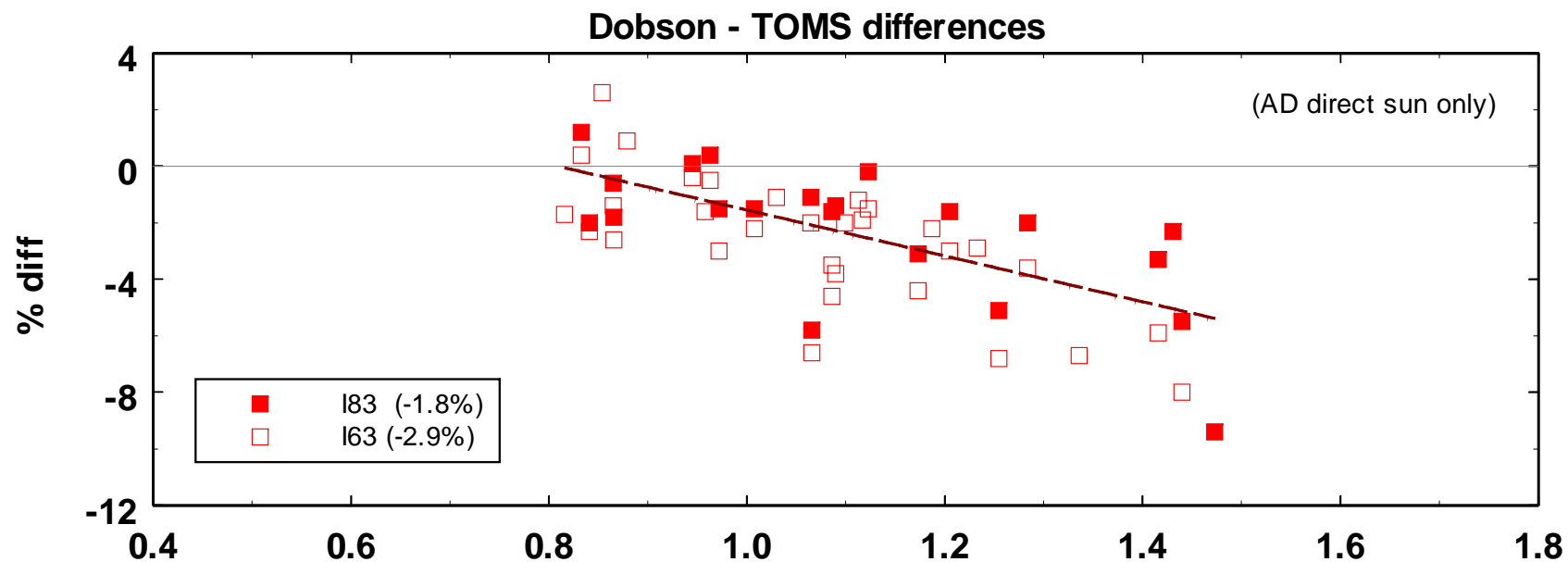
Internal Calibration
Well-designed Algorithms
Internal Checks

- TOMS has Multiple Diffusers

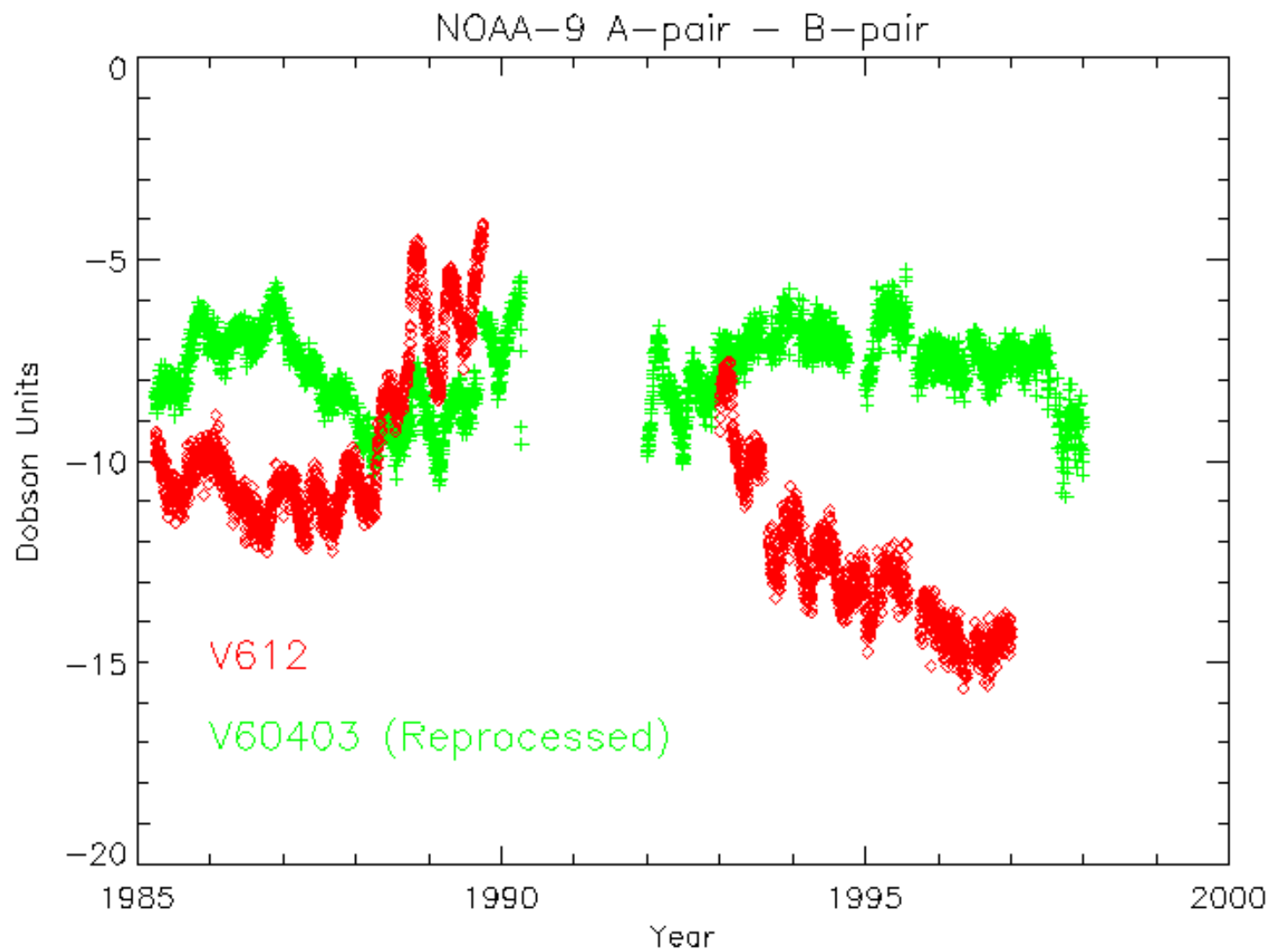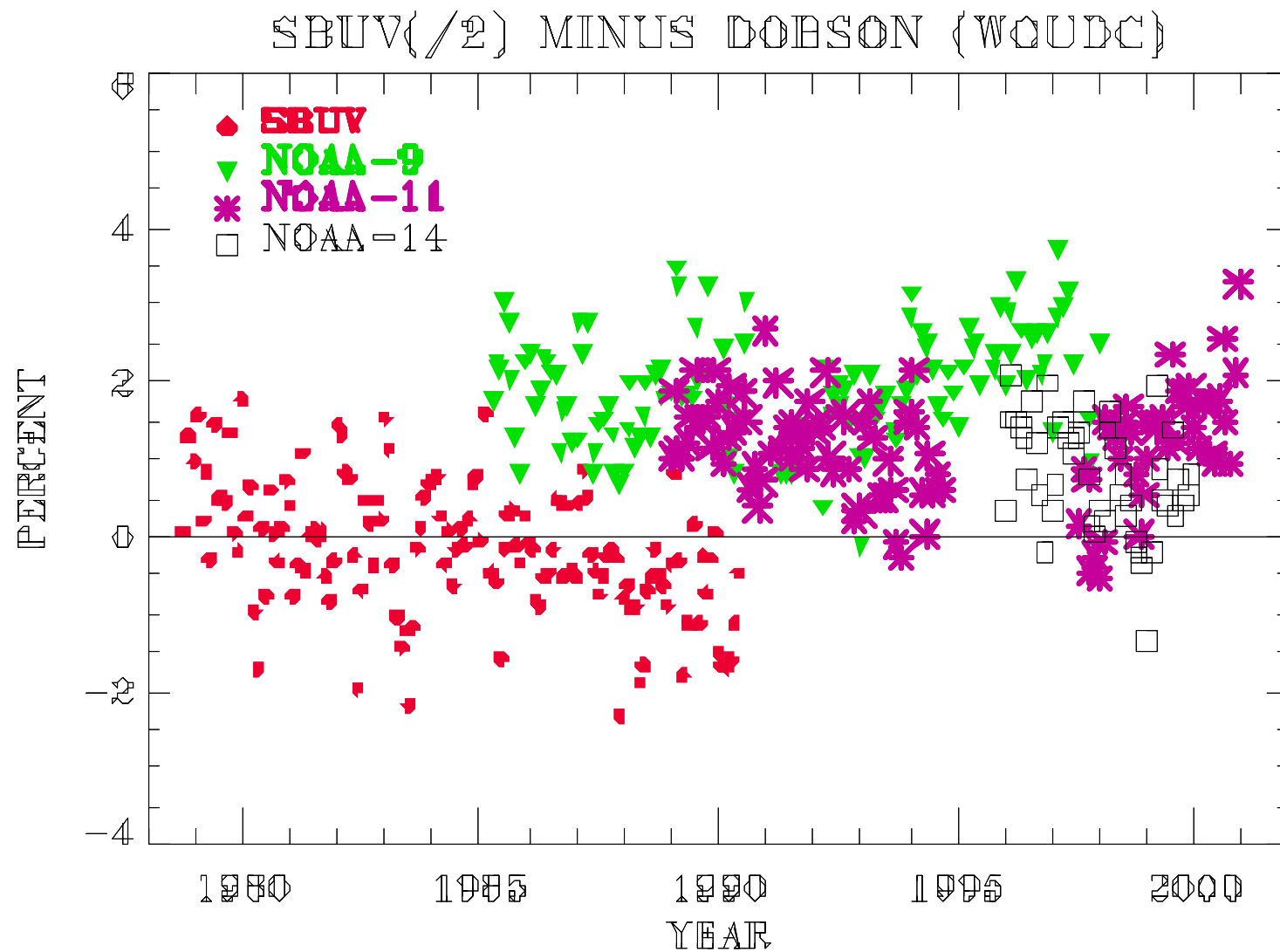- Dobson has Pairs of Pairs

- SBUV/2 has D-pair Measurements

NOAA-9 A-pair − B-pair

V612

V60403 (Reprocessed)

Provided by S. Kondragunta, NOAA/NESDIS.

SBUV(/2) MINUS DOBSON (WOUDC)

In press, Miller et al., JGR Atmospheres

L. Flynn, NOAA/NESDIS, Slide 13

WMO #140 Recommendations

International cooperation and collaboration for science synergism and cost effectiveness. Integrate satellite and ground based systems

- Accurate calibration to minimize systematic bias between observing systems
- Comparisons of algorithms and reference radiative models
- Temporal and spatial coverage (space and ground) to insure science requirements are met
- Coordinated satellite operations to enhance science and minimize gaps
- Data production and archiving for maximum user accessibility
- End-to-end validation and maintenance of ground network

Provided by E. Hilsenrath, NASA/GSFC

End-to-End Cal/Val
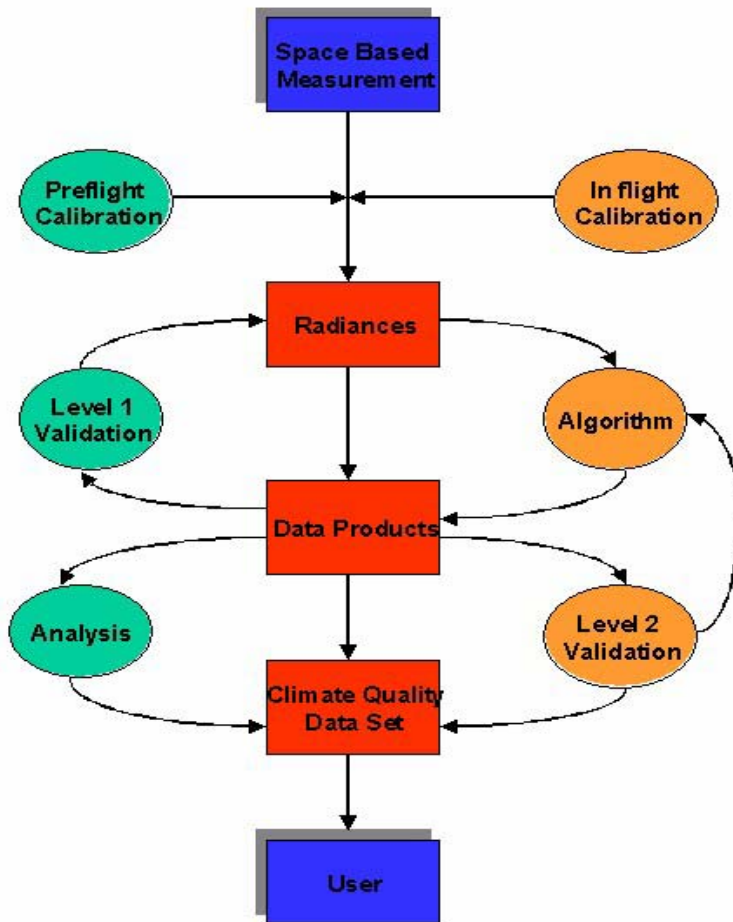
WMO/GAW #140, Strategy for Integrating Satellite and Ground Based Observations of Ozone

Validation and data analysis is an iterative process

1. Prelaunch, in-flight calibration, and Level 1 validation checks instrument sensitivity changes.

2. Level 2 comparisons and data analysis with chemical transport models and data assimilation validates geophysical data products.

3. Long term validation for climate research requires reprocessing and reiterating through steps 1 and 2.

Provided by E. Hilsenrath, NASA/GSFC